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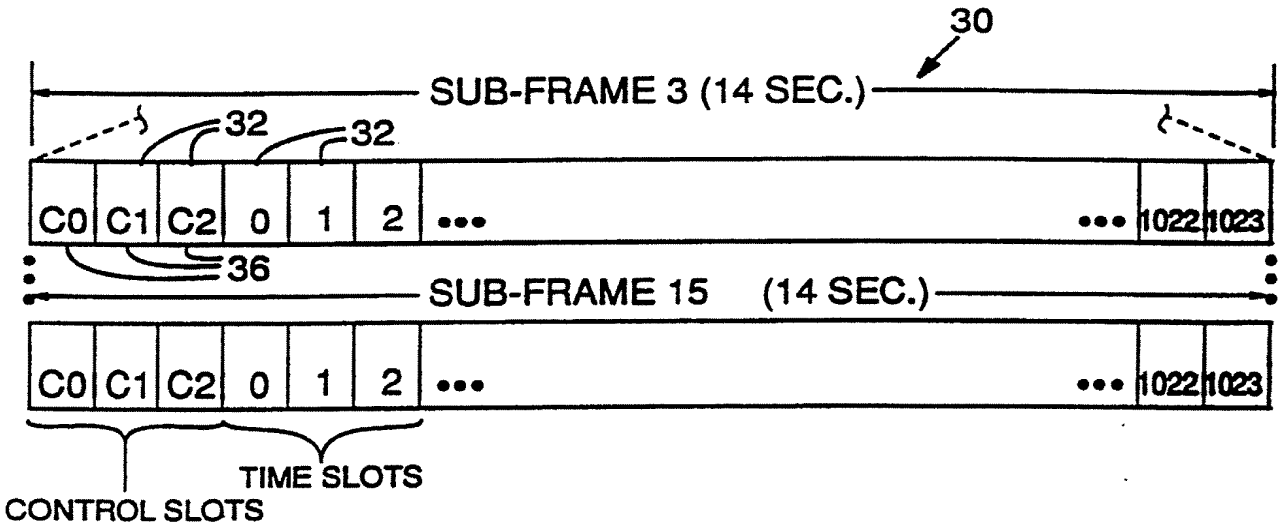
(54) Title: PAGING SYSTEM WITH TIME SLOT REASSIGNMENT



(57) Abstract

A time division multiplexed paging method (30) includes transmitting in a single time slot the addresses of a plurality of receivers. Associated in the time slot with each address is a message datum. This datum can either be a code signifying a predetermined message, or a pointer to a subsequent time slot in which a message for the corresponding receiver is to be transmitted.

PAGING SYSTEM WITH TIME SLOT REASSIGNMENT

Related Application Data

This application is a continuation-in-part of copending allowed application Serial No. 07/352,635, filed May 12, 1989, which is a continuation-in-part of application Serial No. 06/802,844, filed November 27, 1985, now U.S. Patent 4,713,808, both of which are incorporated herein by reference.

Field of the Invention

The present invention relates to time-division multiplexed paging systems, and more particularly relates to a method of dynamically reassigning time slots so as to avoid several messages conflicting in the same time slot.

Background and Summary of the Invention

Time-division multiplexed paging systems are well known in the art, as illustrated by the above-referenced patent and allowed patent application. In such systems, each paging receiver energizes at a predetermined time slot and decodes a recipient identifier code transmitted therein. If this identifier matches the receiver's own, the receiver remains energized to receive the accompanying message. At the conclusion of this operation, the receiver is deenergized until the beginning of the next predetermined time slot.

The transmission of a recipient identifier code permits multiple receivers to be assigned to a single time slot. A problem arises, however, when messages must be broadcast to two receivers that share the same time slot.

One possible solution to this problem is to transmit a first one of the messages in the time slot, together with a data bit indicating that there are other messages for that time slot. The other message(s) are

receivers that normally monitor these latter time slots themselves need only energize once, since they recognize immediately that the time slot contains no messages tagged with their identifier codes.

The foregoing and additional objects, features and advantages of the present invention will be more readily apparent from the following detailed description thereof, which proceeds with reference to the accompanying drawings.

Brief Description of the Drawings

Fig. 1 is a schematic block diagram illustrating a paging system that may use the present invention.

Fig. 2 is a schematic block diagram illustrating a wristwatch paging receiver used in the system of Fig. 1.

Fig. 3 is a block diagram illustrating the partial contents of a microprocessor memory used in the paging receiver of Fig. 2.

Fig. 4 illustrates the format of a frame that may be used in a paging system according to the present invention.

Fig. 5 illustrates the format of a subframe that may be used in a paging system according to the present invention.

Fig. 6 illustrates the format of an A1 time slot that may be used in a paging system according to the present invention.

Fig. 7 illustrates the format of an A2 time slot that may be used in a paging system according to the present invention.

Detailed Description

For expository convenience, the present invention is illustrated with reference to a paging system (the "Gaskill" system) described in U.S. Patents 4,713,808 and

the frequency agile receiver 18. The frequency agile receiver 18 processes the RF signals from the antenna and produces baseband output signals corresponding to a desired FM station within the reception band -- typically an FM signal carrying the paging data on an SCA subcarrier thereof. This SCA paging data is detected by the data demodulator 20, decoded by the protocol decoder 21 and is provided to the microprocessor 22 for processing. The microprocessor 22 drives the user interface 26 to alert the subscriber of paging messages.

The format for transmitting messages is shown in Figs. 4 - 7. The format comprises a time frame 28 (Fig. 4) of predetermined length, such as fifteen minutes, which is repeated cyclically. Within each frame 28 are a predetermined number of subframes 30 (sixty four in the illustrated embodiment). Each subframe is uniquely numbered 0,1,2...63.

Moving to Fig. 5, each subframe comprises a predetermined number of time slots 32 during which a packet of data is transmitted. In Fig. 5, 1024 time slots of about fourteen milliseconds each are shown. Each time slot is uniquely numbered 0,1,2,3...1023. Subframe and time slot number information are sent in the transmitted data and are used by the receivers to determine a reference point within a frame.

The 1024 time slots in each subframe are preceded by three control time slots 36 which include packets of control information. Control slots 36 are like time slots 32 in both duration and format, but differ in information content, as disclosed in the above-referenced patents.

Each paging receiver is assigned a particular time slot 32 (Fig. 5) in a subframe in which its messages will be broadcast. In the illustrated system, there are 65,536 such time slots. To increase system capacity, each time slot serves several receivers. (Each paging receiver is uniquely identified by a 32 bit ID code. The time slot

ten-bit message datum. The message datum can either represent a predetermined message (such as "Call Home," "Call Office," etc.), or can serve as a pointer to a subsequent time slot in which a user-defined message will be transmitted, typically in an A1 packet. (The paging system selects this subsequent time slot from those that would otherwise not convey a message.) Also included in each of these three message blocks is a sequential message number datum and a format datum. The format datum can assume several values to indicate (a) that the block is devoid of a message; or (b) that the message datum represents a predetermined message; or (c) that the message datum is a pointer to a subsequent time slot.

In the preferred embodiment, the A2 packet format is used whenever a predetermined message is to be sent (regardless of the number of receivers addressed), or whenever more than one receiver is to be addressed (regardless of the message type - predetermined or user-defined).

From the foregoing, it will be recognized that the present invention advantageously solves the problem of serving several receivers simultaneously from a single time slot, and does so in a manner that balances the message load among the time slots, rather than imposing additional message burden on time slots that may already convey messages.

Having described and illustrated the principles of my invention with reference to a preferred embodiment, it will be apparent that the invention can be modified in arrangement and detail without departing from such principles. Accordingly, I claim as my invention all such modifications as may come within the scope and spirit of the following claims and equivalents thereto.

an improvement comprising:

providing to each of two receivers, from a single time slot, data indicating two future target time slots in which messages addressed to said two receivers may be received, respectively.

6. The method of claim 5 which further includes providing to each of three receivers, from said single time slot, data indicating three future target time slots in which messages addressed to said three receivers may be received, respectively.

7. In a time division multiplexed communications system that includes transmitting data in packet form to a plurality of receivers that monitor a periodically recurring time slot, an improved packet format comprising:

a first address field containing data identifying a first receiver;

a first message field containing a message datum intended for the first receiver;

a second address field containing data identifying a second receiver; and

a second message field containing a message datum intended for the second receiver;

wherein said plurality of receivers numbers more than two.

8. The time division multiplexed communications system of claim 7 in which the packet format further includes:

a third address field containing data identifying a second receiver; and

a third message field containing a message datum intended for the third receiver;

wherein said plurality of receivers numbers more than three.

FIG. 1

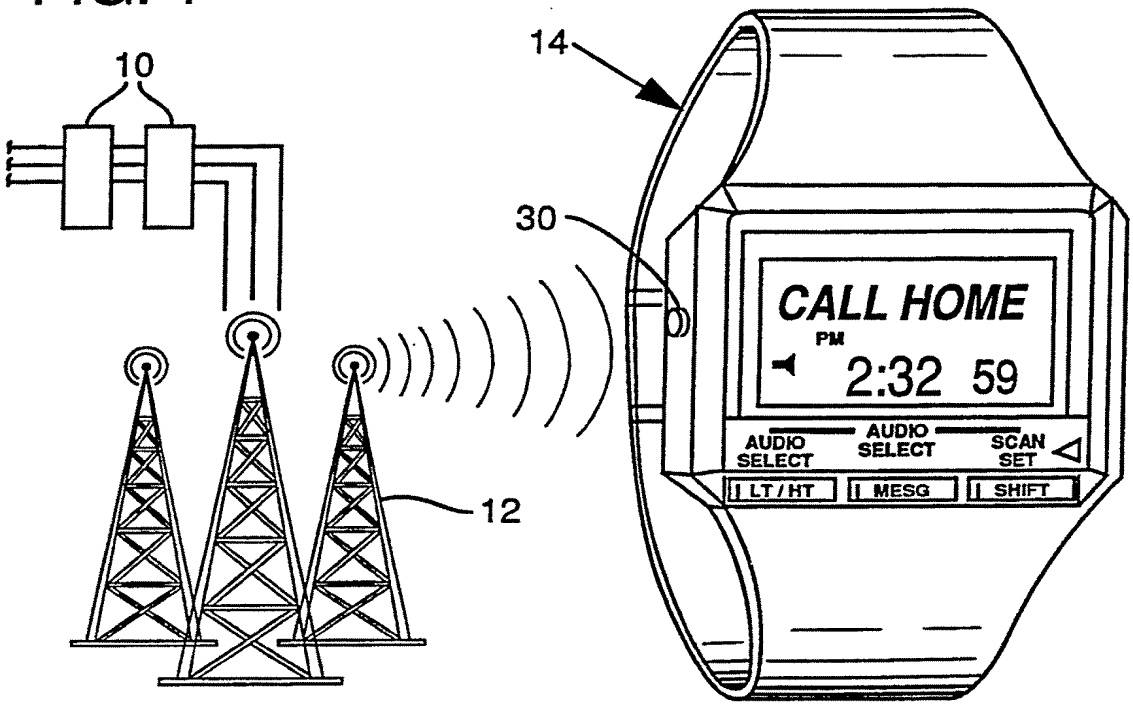


FIG. 2

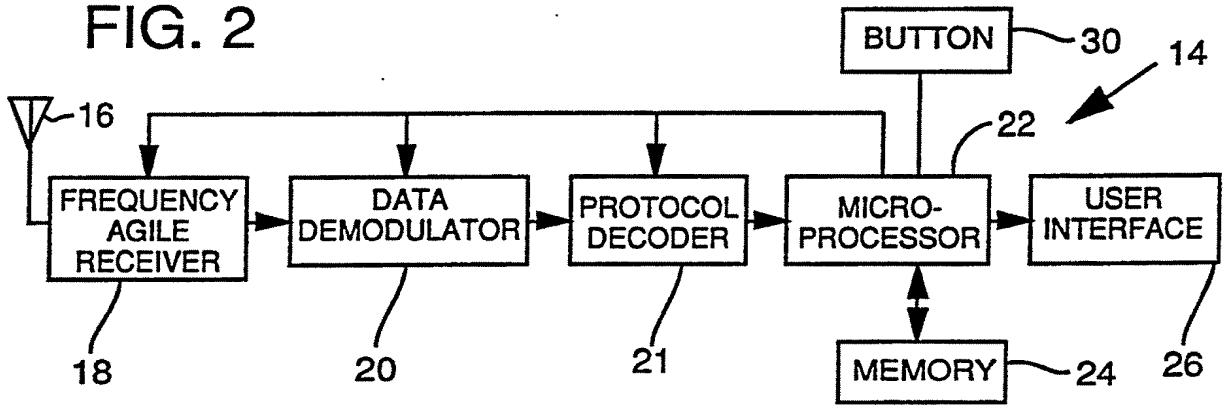
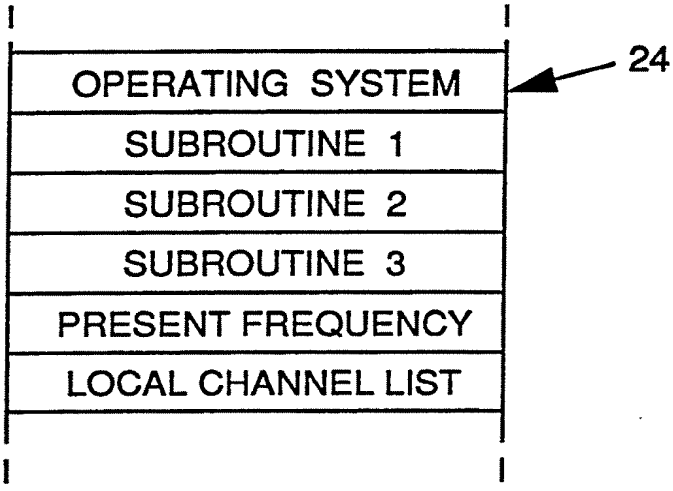


FIG. 3



INTERNATIONAL SEARCH REPORT

International Application No PCT/US91/00614

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC(5): H04J 3/26
US CL. 370/94.1

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
US	370/93, 94.1, 95.1, 95.3 340/825.44 379/57, 63

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
X Y	US, A, 4,706,272 (Nishimura et al.), 10 November 1987, Column 2, line 59 to column 3, line 45.	1,2,7,8 3-6,9-11
Y	US, A, 4,713,808 (Gaskill et al.), 15 December 1987 column 23, lines 22-26 and 39-43.	3-6,9-11
A, P	US, A, 4,897.835, (Gaskill et al.), 30 January 1990.	
A	US, A, 4,641,304, (Raychandhuri) 03 February 1987.	

* Special categories of cited documents: [15]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
11 March 1991	24 APR 1991
International Searching Authority [1]	Signature of Authorized Officer [20]
ISA/US	Nguyen Ngoc-Ho Nguyen NGUYEN NGOC-HO for Melvin Marcelo INTERNATIONAL DIVISION

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